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Policy Brief

Round goby – a threat or a new resource?

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Content

- 05 Round goby – a threat or a new resource?
- 06 The pan-Baltic invasion history of round goby and examples of negative impacts
- 09 Round goby in relation to Good Environmental Status and Marine Protected Areas
- 11 Round goby as an emerging prey item and potential new resource
- 13 Conclusions and recommendations



European perch eating round goby. Photo: Riikka Puntila-Dodd

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Round goby

– a threat or a new resource?

Since it was first observed in 1990 in the Polish Gulf of Gdansk, the round goby has established dense populations in many coastal areas throughout the Baltic region. Round goby is considered an invasive species with several documents of negative effects occurring in the wake of its invasion, e.g. reduction or even elimination of benthic prey species such as mussels and shrimps, and reducing abundance of commercially important fish species through competition for food and territory. Yet, in recent years, emerging evidence points to that this new fish may also constitute a supplementary prey for piscivorous predators.

To fully understand the impact and role of round goby in invaded ecosystems, not only the hazardous effects of this invasive species should be documented, but also potential benefits arising from its presence. The latter includes both the potential for round goby as a new resource for the fishing industry, a matter currently addressed by several countries around the Baltic, and also round goby as prey for piscivorous fish, marine birds and mammals.

This policy brief summarizes the status for the invasion of round goby in the Baltic region, and elucidate available knowledge on the potential for round goby as an emerging prey, including suggestions for future research and management efforts.



Round goby catch in passive gear. Kalvehave, Denmark. Photo: John Petersen

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The pan-Baltic invasion history of round goby and examples of negative impacts

The round goby has been invading the Baltic Sea since early 1990s and has established populations in all Baltic Sea sub-basins. It is currently considered one of the top invasive species in the Baltic Sea. Currently the species is expanding its range towards more saline waters in the west as well as to less saline waters in the north and east. Round goby has also entered fully freshwater environments, such as small rivers in Sweden

and Denmark (Gotland 2016 and nearby Kalmar 2017), rivers in the northern coast of Estonia and is numerous in freshwater Curonian lagoon in Lithuania.

The round goby originates from the Ponto-Caspian region and was likely transported to the Baltic Sea via ballast water. The first record of the round goby in the Baltic Sea was made in Poland at the tip of Hel Peninsula, Gulf of Gdansk in

1990 and by mid-1990's it was present in almost the entire Polish part of the Gulf of Gdansk, and had also been reported outside the Gulf. Round goby spread in the Baltic Sea occurred rapidly and by 2011, it was detected in all sub-basins. The spread in the Baltic Sea has followed a dual pattern: long-distance spread is associated with shipping and short distance natural spread locally.

The round goby has typical biological and ecological features for an invasive species such as rapid reproduction, aggressive behavior and ability to sustain variable biotic and abiotic conditions. Although their physiological performance in sub-optimal environments (such as high salinity in western Baltic Sea) may be reduced to some extent, the increasing salinity towards the North Sea will likely not prevent further spread.

Round gobies are aggressive, territorial and voracious benthivorous fish. They exert top down impacts on their prey and competitive impacts on native species with similar ecology especially where numerous. Round gobies are generalists and opportunistic benthic predators reported to prefer bivalve prey, but their diets can be highly diverse and include a

variety of benthic prey and even fish. Large round goby populations in the Lithuanian coast have likely contributed to local depletion of blue mussel banks. However, the fish appear to be able to persist and reproduce also where their preferred bivalve prey is not available or scarce (for example in the Bothnian Bay), indicating that the prey field is not limiting their success.

Species with similar ecology, such as the native black goby (*Gobius niger*), have decreased or vanished in many locations at the presence of round gobies. Furthermore, European flounder (*Platichthys flesus*) has shown a shift in its foraging as a result of increased round goby densities in many locations in the Baltic. In addition, the round goby is capable of consuming small flounders.



Great Crested Grebe with a round goby in its beak. Photo: Alamy

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Round goby in relation to Good Environmental Status and Marine Protected Areas

In the Marine Strategy Framework Directive (MSFD, 2008/56/EG) introduced species is included as a descriptor (Descriptor 2) of environmental status. In order to achieve Good Environmental Status (GES) introduced species must be on a level that does not affect the ecosystem negatively. The current high density of round goby in many areas of the Baltic Sea makes the likelihood large of negative effect on native fauna by for example predation and/or competition (see above) preventing the achievement of GES.

The invasion of round goby also affects the possibility to reach GES in other descriptors; maintaining biological diversity (Descriptor 1), populations of commercially exploited fish and shellfish species within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock (Descriptor 3), functional food web (Descriptor 4), sea floor integrity at a level ensuring benthic ecosystems not adversely affected (Descriptor 6). The invasion of round goby affects the possibility of member

states to reach all these goals. However, round goby can also contribute to GES positively if marine exploited fish species like cod benefits from its abundance. Therefore, it is hard to foresee if the overall effect on the ecosystem of round goby will be positive or negative in the sense of good environmental status.

Marine protected areas (MPAs) are constructed to protect valuable and threatened species or habitat. However, many MPAs in Europe are situated in coastal shallow areas, i.e. suitable habitats for round goby and high abundance of round goby may compromise the objectives of the MPA. Since fishing is often prohibited in MPAs they could also become dispersal centers with a negative effect also in adjacent areas. It is therefore important when designing the MPA to also take the existence of nonindigenous species such as the round goby into consideration, and for example allow a selected removal of the species within the MPA or make sure the native predators are at a high abundance to mitigate negative effects from the round goby.



Round goby in cod stomach, Bornholm. Photo: Marie Møhl



Round goby as an emerging prey item and potential new resource

In regions where round gobies have become abundant, they have become important prey items for piscivorous predators. They are e.g. the main prey for cod and perch in the Gulf of Gdansk and increasingly important prey for perch in Estonia. In Lithuania round gobies were found in the diet of most piscivorous fish species including turbot or even such species as Shorthorn sculpin, the same being the case in the Curonian Lagoon, where it is part of the diet of all top predators. Some piscivorous fish, such as sander, show higher length-at-age values after the invasion. Furthermore, the nutritional value of round goby, having a high protein content and a favorable fatty acid composition makes it a superior prey for growth of cod. Round gobies are also important prey for piscivorous birds, such as great cormorant and grey heron. Thus, it is clear that positive effects of round goby are also to be seen in the wake of its invasion.

Round goby is target species for fisheries in its native range. It is considered tasty and it may gain popularity as a catch, also in the invasive range, and in Denmark and Sweden there are ongoing efforts to develop products for human consumption of the fish, e.g. fish filets and patties. The meat is fine, white, with a favorable texture, and fishing with passive gear is most cost-efficient in spring and early summer, where the fish are most active before breeding starts. In Latvia, a commercial fishery has developed and in 2018, more than 1000 tons were landed. Recreational angling for round goby has already become popular in Lithuanian coastal waters and the fish has become a valued catch.



Round goby catch. Kalvehave, Denmark. Photo: John Petersen↑

Conclusions and recommendations

Experience from all invaded regions show that when round goby has established, populations eradication is highly unlikely. Yet mitigation measures may ensure that densities are kept at acceptable levels to minimize negative impact on the invaded ecosystem. Fishing effort is an obvious mean to reduce abundances, yet in many countries round goby is not, at least yet, a valued species for human consumption. Often the public envisage the term 'invasive species' negatively, which does not foster utilization for human consumption, hence making it difficult for the fishers to obtain an acceptable prize. For example, in

Denmark the tabloid press has given the fish the nickname 'the killer slug of the sea'. Thus, branding is required, to create a positive image of the species.

After a few years where native predators have been reluctant to prey on this new fish, it is now clear that round goby constitutes a major proportion of the diet of predators foraging in coastal waters, especially piscivorous fish. Consequently, another way to keep control of the abundance of round goby is to support natural resilience by assuring that the predators of this fish are present in adequate amounts.

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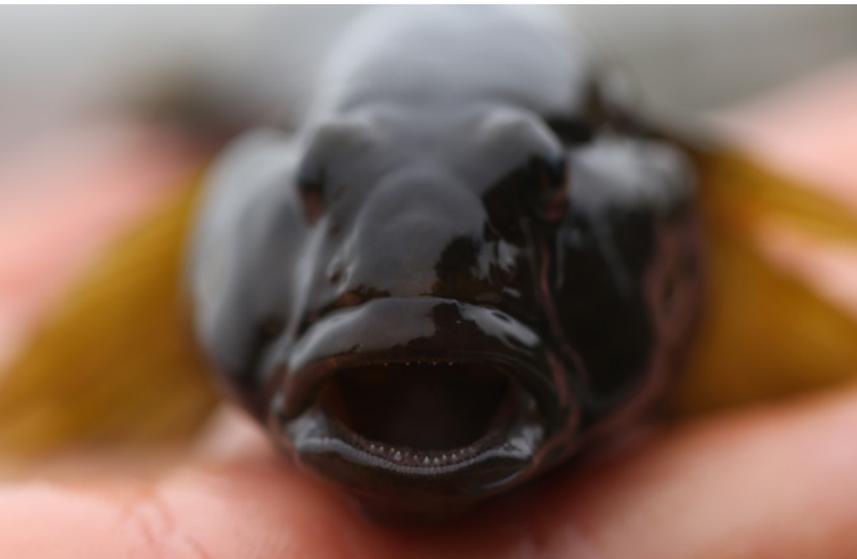
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Round Goby
Photo: Mads
Christoffersen
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Facts about round goby

Latin name: *Neogobius melanosomus*.

Family: Gobiidae.

Habitat: Lives in coastal areas on shallow water, but migrate into deeper waters during the coldest months.

Reproduction: Spawning takes place from around May and until August, and a female may spawn up to six times during a season. Either eggs are laid onto various structures, or the males make nests

in which several females spawn, and the males exhibit nest guarding behavior.

Area of origin and dispersal: Round goby is native to the Ponto-Caspian region and has been introduced to the Baltic Sea via ballast water in ships. From points of introduction (typically harbors) the fish has spread by migration along the coastline.

Food: Round goby has a broad diet, feeding on various invertebrate species, and on fish eggs, if available.

Round Goby.
Photo: Mads
Christoffersen
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Originating from the Ponto-Caspian region, the invasive round goby has since 1990 spread in the Baltic Sea region, now with established populations throughout the area. The fish is a strong competitor for food, shelter and nesting sites, and has a high tolerance towards a broad range of temperatures and salinities. In many places, it exerts negative effects on the local fish fauna and benthic community, and its presence may compromise descriptors of Good Environmental Status under the Marine Strategy Framework Directive. Furthermore, Marine protected areas, constructed to protect valuable and threatened species or habitats, may be compromised by its presence. Notably however, round goby is also an emerging prey for larger fish, marine mammals and birds, thus providing positive effects to the invaded ecosystems. In some areas, it also supports fisheries, adding positively to society.